RECOVERY PLAN FOR THE TAMMAR WALLABY (*MACROPUS EUGENII*)

by

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SUMMARY

Current species status: Vulnerable on the mainland, stable on islands (IUCN/SSC 1991). Formerly abundant but has declined to 7 mainland and 3 island populations in WA, and 4 islands in SA. Mainland SA race extinct. Introduced to Kawau Island, New Zealand.

Habitat requirements and limiting factors: Remaining forests and woodlands in southern Australia can support viable populations provided exotic predators are controlled.

Recovery Plan objectives: Protect mainland populations from exotic predators. Establish additional mainland populations. Maintain security of island populations. Downlisting of mainland populations to rare within 10 years. Indefinite protection due to threat of exotic predators.

Recovery criteria:
2 years - In WA, effective exotic predator control over existing mainland populations to allow a measurable increase in numbers. Conserve island populations. In SA, conserve island populations.
5 years - In WA, successful translocation of 50 animals to a new mainland site. In SA, at least 50 New Zealand animals released and feral cats eradicated on Flinders Island.
10 years - In WA, establishment of 4 mainland populations containing at least 5000 adults, and conservation of island populations. In SA, several hundred animals on Flinders Island, and at least 50 animals translocated to Venus Bay peninsula following vermin-proof fencing and exotic predator and rabbit control.

Actions needed: The following actions will be overseen by a Recovery Team composed of people from CALM, SANPWS, ANPWS and other organisations relevant to the recovery process.
In Western Australia:
1. Exotic predator control
2. Genetic assessment of populations
3. Population monitoring
4. Translocations

In South Australia:
1. Cat eradication from Flinders Island
2. Translocation from NZ to Flinders Island
3. Genetic analysis of populations
4. Population monitoring

Total estimated cost of recovery (1991 prices in $000/year):

Western Australia

Action	1		2		3		4		Totals	
YEAR	TC	ESP	TC	ESP	TC	ESP	TC	ESP	TC	ESP
1992	51.0	22.8	9.0	9.0	49.6	24.9	-	-	109.6	56.7
1993	51.0	22.8	-	-	-	-	21.7	15.5	72.7	38.3
1994	51.0	22.8	-	-	49.6	24.9	5.6	2.5	106.2	50.2
1995	51.0	22.8	-	-	-	-	5.6	2.5	56.6	25.3
1996	51.0	22.8	5.0	5.0	49.6	24.9	5.6	2.5	111.2	55.2
1997	51.0	22.8	-	-	-	-	5.6	2.5	56.6	25.3
1998	51.0	22.8	-	-	49.6	24.9	5.6	2.5	106.2	50.2
1999	51.0	22.8	-	-	-	-	5.6	2.5	56.6	25.3
2000	51.0	22.8	-	-	49.6	24.9	5.6	2.5	106.2	50.2
2001	51.0	22.8	5.0	5.0	-	-	5.6	2.5	61.6	30.3
TOTAL	510.0	228.0	19.0	19.0	248.0	124.5	66.5	35.5	843.5	407.0

Total cost (TC) and Endangered species program (ESP) contribution

South Australia

Action	1		2		3		4		Totals	
YEAR	TC	ESP	TC	ESP	TC	ESP	TC	ESP	TC	ESP
1992	40.0	40.0	-	-	5.5	5.5	-	-	45.5	45.5
1993	20.0	20.0	-	-	-	-	-	-	20.0	20.0
1994	20.0	20.0	-	-	-	-	-	-	20.0	20.0
1995	-	-	32.5	32.5	-	-	-	-	32.5	32.5
1996	-	-	5.0	5.0	1.5	1.5	11.5	11.5	18.0	18.0
1997	-	-	-	-	-	-	-	-	0	0
1998	-	-	5.0	5.0	-	-	11.5	11.5	16.5	16.5
1999	-	-	-	-	-	-	-	-	0	0
2000	-	-	5.5	5.5	-	-	-	-	5.5	5.5
2001	-	-	-	-	1.5	1.5	11.5	11.5	13.0	13.0
TOTAL	80.0	80.0	48.0	48.0	8.5	8.5	34.5	34.5	171.0	171.0

Total cost (TC) and Endangered species program (ESP) contribution

Biodiversity benefits: In WA, predator control will allow for the recovery of a further 4 endangered species. Genetic assessment will allow quantification of the presumed effects of inbreeding on genetic variability. These data will be applicable to conservation genetics of numerous species. In SA, several species of sea- and shore-birds will benefit from cat eradication from Flinders Island, which may then also be suitable for translocations of other threatened species. The control of vermin from Venus Bay peninsula will also benefit the proposed reintroduction of brush-tailed bettongs.

1. INTRODUCTION

1.1 General

The Tammar Wallaby, *Macropus eugenii*, is a medium-sized marsupial which was once common in areas of southern Australia with a mediterranean climate of winter rainfall and summer drought (Fig. 1). Throughout this range the species inhabited dry sclerophyll forest and woodland, heath, coastal scrub and mallee thickets (Smith 1983). Its food consists largely of grasses and it appears to need drinking water for survival. The species has such a wide tolerance to salinities that it is able to maintain body weight while drinking sea water. The species is nocturnal and only emerges after dark. During the day animals rest in thick scrub thickets.

1.2 Breeding

Breeding appears to be seasonal with most young being born between January and March (Smith 1983). The female gives birth to its first young at 9 months but males do not become mature until two years old. The single young remains in the pouch for 8-9 months and leaves it in September or October.

1.3 Taxonomy

Poole *et al.* (1991) used cranial morphometrics to assess relationships between both extinct and extant populations. These data support the existence of three major regional groups - one predominantly from Western Australia, another from Kangaroo and Greenly Islands and a third from New Zealand. All are apparently related via a population from Eyre Peninsula.

Cooper *et al.* (1991) used isozyme electrophoresis to examine the relationships between the various populations. Their data showed significant differences existed between the Western Australian populations.

1.4 Reasons for listing

Several authors (e.g. Christensen 1980, Burbidge and Jenkins 1984, Burbidge and McKenzie 1989) have suggested that a major factor contributing to the decline of the tammar, and numerous other species, has been predation by introduced predators such as the fox and cat. Dr J. Kinnear of CALM (pers. comm.) has evidence that when fox control is effective, tammar numbers increase (Figure 2).

Since European settlement the clearing of bushland for agriculture has significantly reduced the shelter available for tammars, and has contracted the range of some populations. Fig. 1 outlines the distribution of tammars in southern Australia. In Western Australia isolated populations still exist on the mainland and some offshore islands. In South Australia all mainland and natural island populations (with the exception of Kangaroo Island) appear to be extinct. This includes the type population from St. Peter Island and the Flinders Island population which became extinct in the early 1970s.

There are probably several inter-related reasons which have led to the currently vulnerable status of *M. eugenii* such that it now occupies a small fraction of its former range. The tammar is gazetted on Schedule 1 of the Western Australian Wildlife Conservation Act 1950 as likely to become extinct and also listed as vulnerable under proposed IUCN listings.

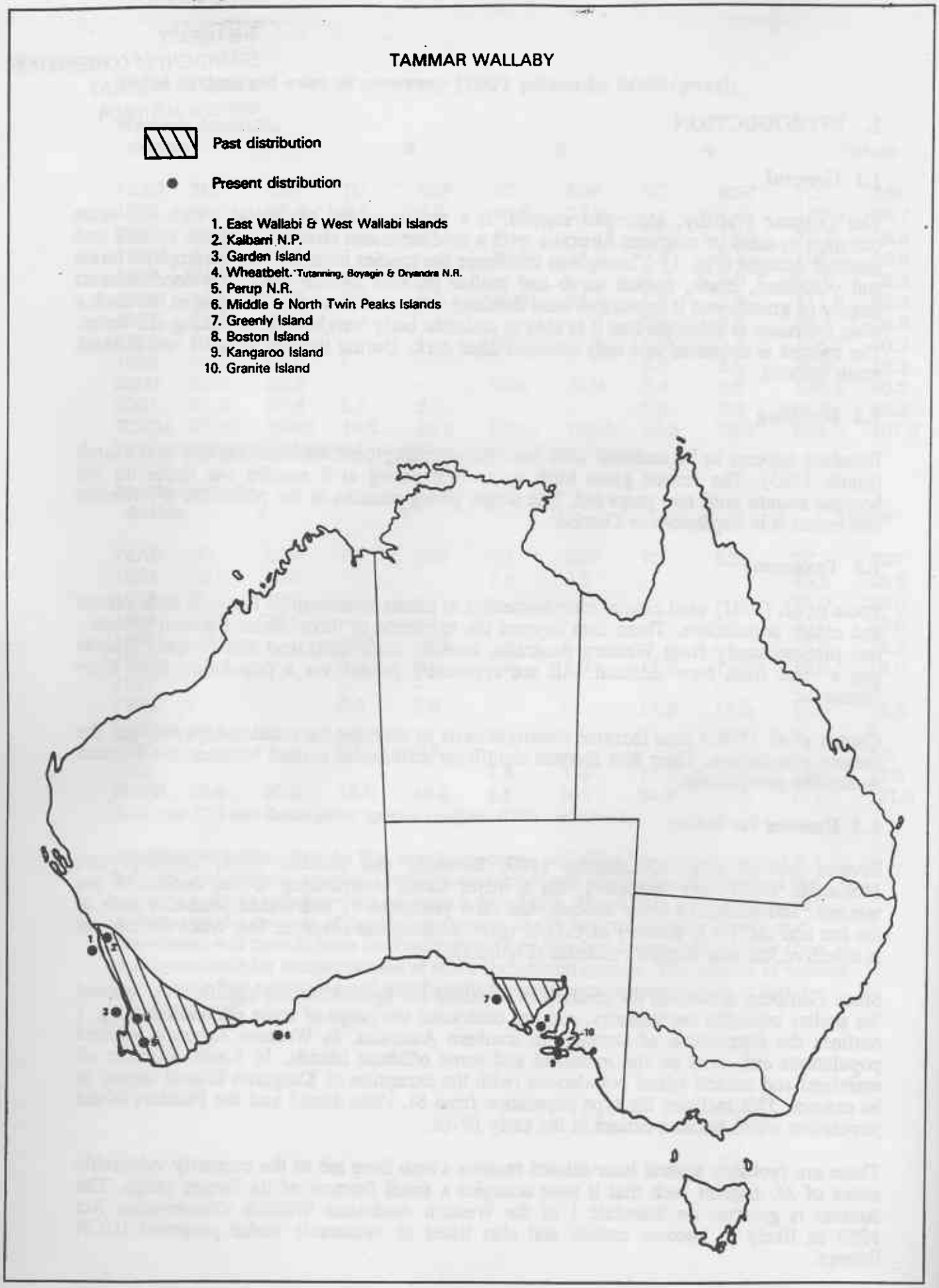
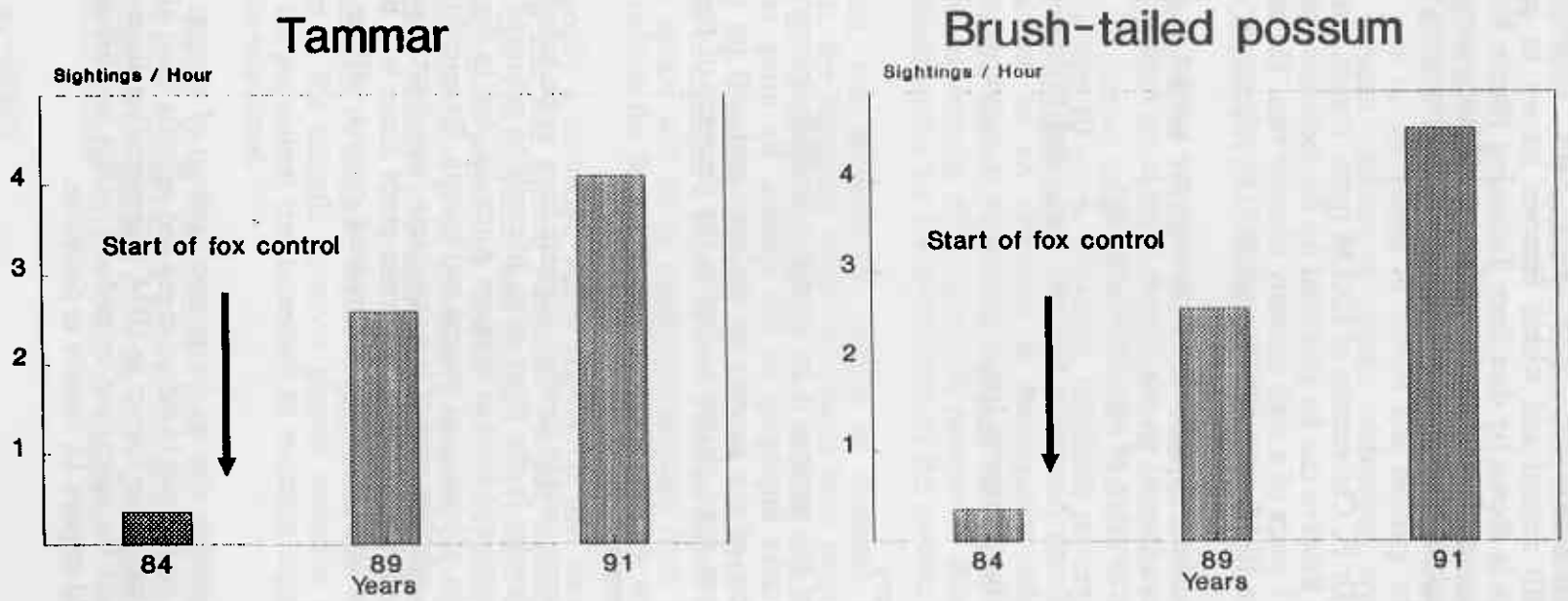


Figure 1. Distribution of the Tammar Wallaby *(Macropus eugenii)* in southern Australia.

Figure 2. Numbers of Tammars & Brush-tailed possums sighted before & after fox control at Tutanning Nature Reserve



1.5 Existing conservation measures

In Western Australia management of mainland populations is directed towards predator control, and the use of prescribed fires in some areas to create dense vegetation cover for shelter and open grassy areas for feeding. This work is conducted by staff from the Department of Conservation and Land Management (CALM). Predator control is achieved with the regular distribution of dried meat baits impregnated with sodium monofluoroacetate (1080) around and within reserves known to contain tammars. The success of this campaign is shown by data from Tutanning Nature Reserve (Figure 2). An average of less than 1 tammar/hour was sighted in a spotlighting survey before baiting and 4 tammars/hour were sighted 5 years afterwards. A similar response was shown by brush-tailed possums.

Research conducted by Dr P. Christensen of CALM (pers. comm.) has shown that tammar habitat in Perup Nature Reserve can be generated by the judicious use of fire. This habitat can be achieved within 7 years of a high intensity summer fire. The area remains attractive for tammars for a further 10-15 years and then needs to be reburnt.

The Western Australian island populations of tammars are subject to minimal interference. As there are no predators present on the islands there is no need to disturb the animals, other than for perodic monitoring of population numbers.

In South Australia the South Australian National Parks and Wildlife Service (SANPWS) has the responsibility for management of tammars. As no mainland populations are believed to remain, and the Kangaroo Island population is secure, no active management is currently operative.

1.6 Strategy for recovery

The recovery strategy of the tammar is to involve a multidisciplinary Recovery Team to implement the various tasks impinging on the species. By using expert personnel it is believed that the recovery of the tammar on the mainland will be achieved rapidly and efficiently. There are three main phases leading to the recovery of the tammar and all can be run concurrently.

1.6.1 Exotic predator control

Numbers of exotic predators within tammar habitats have to be substantially reduced and then maintained at low levels. In the short term this will be achieved through the regular distribution of 1080-impregnated baits in Western Australia, but in the longer term may be achieved by a combination of biological control and baiting. Research into the methodology and cost-effectiveness of predator control is a separately funded program, but is pertinent to the recovery process. In South Australia, a vermin-proof fence will be erected across the isthmus leading to Venus Bay peninsula and predator control will be implemented across the peninsula.

1.6.2. Genetics

The effects of small population size on the genetic makeup of tammar populations will be examined. Tammars can be trapped in baited cages and animals from all populations can be obtained. The molecular technique known as DNA fingerprinting allows for parentage to be assigned to individuals and for estimating relatedness within and between populations. An initial genetic study would require 12 months to complete.

1.6.3. Translocations

The habitat requirements of the tammar are broadly known and the techniques to modify these habitats through the use of prescribed fires and exotic predator control are established. Additional areas with potential for tammar releases in Western Australia will be identified. Those areas with extant populations will be actively managed to maintain habitat heterogeneity.

Once the above goals of exotic predator control and genetic assessment have been achieved, a minimum of 50 animals will be translocated into each prepared area. Post-release and annual monitoring will be conducted to ensure the security of the populations. If any problems, such as reduced numbers or genetic inbreeding, are discovered they will be resolved.

2. RECOVERY OBJECTIVES AND CRITERIA

The objective of the Tammar Wallaby Recovery Plan is to protect existing mainland and natural island populations from exotic predation, and establish a number of new mainland populations within the former range of the species. The aim is to achieve down-listing of the species to rare within 10 years. However, indefinite protection of the species will be required because of the predation threat.

In Western Australia the tammar will be considered recovered when the total number of adults on the mainland exceeds 5000, and this number is distributed among at least 4 independent populations within the historical range of the species.

There are persistent, but unconfirmed, reports of tammars in other areas. If other populations do exist, the Recovery Team will ensure their persistence or, if too small or threatened for long term viability, translocate them to more secure areas.

In South Australia the recovery strategy will be to conserve the extant population on Kangaroo Island and re-establish a population on Flinders Island following a cat eradication program. The best option will be to translocate animals from New Zealand to Flinders Island so as to re-establish the South Australian mainland stock within the State.

It is difficult to specify a minimum viable population size because of variables such as effective population size and genetic variation. Various authors (eg, Frankel and Soule 1981, Schonewald-Cox 1983, Shaffer and Samson 1985) have stressed the importance of chance events on population persistence, and the time frame used in conservation planning. However, of critical importance is the genetically effective population size. Consequently it is necessary to measure effective population size or monitor genetic variation.

It would be very difficult to measure effective population size for the tammar because of the secretive nature of the animal. However genetic variation can be assessed by DNA fingerprinting and the population size necessary to maintain significant amounts of genetic variation can then be calculated.

Genetic variation should be a fundamental goal for the long term maintenance of populations. Shorter term considerations such as size and growth rate may take precedence in management practices. Nevertheless once the short term persistence of the population is secure, management for genetic variability can be practised.

3. RECOVERY ACTIONS

The management of the recovery process for the tammar will be overseen by a Recovery Team. The team will be composed of personnel from CALM, SANPWS, ANPWS and

other organisations with expertise in the various aspects of the recovery. A major task of the team will include the writing of management prescriptions for known tammar populations, and the identification of additional areas on the mainland suitable for new tammar populations. The team will report anually to the Executives of CALM and SANPWS.

The Team will act in a pro-active way to the recovery process. If reports of new tammar populations are confirmed, these populations will be assessed and appropriate management actions determined for them.

3.1 Western Australia

3.1.1 Exotic predator control

Exotic predator control is crucial to sustained recovery of the tammar on the Western Australian mainland. Therefore the experimental 1080 baiting program within tammar habitats will be expanded, and incorporated into standard management practices by CALM regional staff. In the long term, exotic predator control may be achieved by biological means. However for the foreseeable future regular baiting will continue.

The costs of a baiting program depend on three variables: frequency of baiting, area baited and the method (aircraft/vehicle) of dispersing the baits. Data from experimental baiting trials in WA (Dr D. Algar of CALM pers. comm.) suggest that dried meat baits distributed twice yearly is adequate to control foxes in most situations. The annual cost of predator control in National Parks and Nature Reserves known to contain tammars is $51.0K.

3.1.2 Genetic assessment

An electrophoretic study of Western Australian tammars showed sufficient differences between populations to justify their conservation as distinct forms (Cooper *et al.* 1991). However, the genetic structure within each population has not been thoroughly investigated. The technique known as DNA fingerprinting allows for parentage to be assigned to individuals and pedigrees within populations to be calculated. It is proposed that 20 animals from each population be subject to DNA fingerprinting so that the probable effects of small population size on genetic diversity can be quantified. These data will assist in future management of genetic diversity.

Based on previous DNA fingerprinting studies by the School of Biomedical Sciences at Curtin University of Technology, the cost of an individual test is $50. Furthermore 20 animals are considered sufficient to give an accurate estimate of the genetic variability within a population. Therefore to examine the island and mainland stocks will cost $9.0K. Subsequently, each population will be genetically monitored in years 5 and 10 and a maximum of 10 young animals/population will be tested for inbreeding. This would cost $5.0K. If evidence of inbreeding is found, the populations should be managed to ensure genetic variability.

3.1.3 Population monitoring

Each population will be monitored every second year to assess the effectiveness of exotic predator control and the rate of recovery. In addition data on population structure and female fecundity will be obtained. The genetic analysis (1.2 above) will be concurrent with monitoring. Costs associated with monitoring will be $49.6K/occasion.

3.1.4 Translocations

Once exotic predator control has been achieved, the genetic structure of potential founders has been determined and suitable habitat identified, translocations of tammars will proceed.

There needs to be some development of techniques for successfully translocating animals. However a trial translocation could begin within 2 years of the start of the Plan. If this is successful, a major translocation could occur within 5 years.

Animals could be relocated to the Stirling Range National Park. This Park is large and contains a number of habitats which are of varying post-fire ages, has a permanent labour force which could assist with monitoring and is subject to low intensity predator control. The Stirling Range is also within the former range of the species, as a specimen was collected near the park in 1907 (Muir and Harold 1983).

A relocation to the Stirling Range would cost $21.7K for salaries, travel, consumables such as traps, and radio telemetry equipment. The annual cost of monitoring the new population and purchase of new transmitters, batteries and maintenance of equipment would be $5.6K.

There are alternative sites including Batalling State Forest where there is already some predator control and suitable habitat. The costs would be similar. The recovery team will choose the translocation site.

3.2 South Australia

3.2.1 Cat eradication from Flinders Island

Poole *et al.* (1991) concluded that the tammars in New Zealand are derived from the now extinct South Australian mainland form. Therefore it would be appropriate to restock areas of South Australia with animals from New Zealand. As tammars formerly existed on Flinders Island, but are now extinct, this island would be a suitable first site for release of tammars.

Before such an exercise could commence the feral cat population on Flinders Island would have to be eradicated. Such an eradication program could be completed within three years and cost $40.0K in the first year and then $20.0K annually for the next 2 years.

3.2.2 Translocation to Flinders Island

The subsequent translocation of 50 animals from New Zealand to Flinders Island would involve $30.0K for travel and capture expenses. All founder animals should be DNA fingerprinted prior to release to establish their genetic relatedness - $2.5K.

The rate of population establishment will be monitored for the first year and then every second year. This process would involve $5K for two people to travel to Flinders Island. The population would be subject to DNA fingerprinting after 5 years ($500) to quantify founder effects.

3.2.3 Genetic analysis

A genetic study of all island populations will be instigated. This would determine the relatedness of animals on each island. The information would be essential to decisions about surplus stock. Given the large size of the Kangaroo Island population 50 animals from various localities should be sampled. However 20 animals from the other three populations would suffice. The initial analysis would cost $5.5K. Sampling 10 animals/population in years 5 and 10 to monitor for inbreeding would cost an additional $1.5K/occasion.

3.2.4 Population monitoring

Each population will be monitored in years 5, 7 and 10 to assess fecundity, age structure and sex ratio as measures of population recovery. The cost of each monitoring occassion will be $11.5K

4. IMPLEMENTATION SCHEDULE

Western Australia

Task#	Task description	Priority	Feasibility	Responsible Party
3.1.1	Exotic predator control	1	90%	CALM
3.1.2	Genetic analysis	1	100%	CALM and Curtin Univ.
3.1.3	Population monitoring	1	100%	CALM
3.1.4	Translocat-ions	2	85%	CALM

South Australia

3.2.1	Cat eradic-ation from Flinders Is.	1	85%	SANPWS
3.2.2	Transloc-ation from NZ to Flinders Is.	1	100%	SANPWS & NZ authorities
3.2.3	Genetic analysis	1	100%	SANPWS & Curtin University
3.2.4	Population monitoring	2	100%	SANPWS

5. BUDGET

In 1991 $000s

Item#	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	TOTAL
Western Australia											
3.1.1	51.0	51.0	51.0	51.0	51.0	51.0	51.0	51.0	51.0	51.0	510.0
3.1.2	9.0	-	-	-	5.0	-	-	-	-	5.0	19.0
3.1.3	49.6	-	49.6	-	49.6	-	49.6	-	49.6	-	248.0
3.1.4	-	21.7	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	66.5
	109.6	72.7	106.2	56.6	111.2	56.6	106.2	56.6	106.2	61.6	843.5
South Australia											
3.2.1	40.0	20.0	20.0	-	-	-	-	-	-	-	80.0
3.2.2	-	-	-	32.5	5.0	-	5.0	-	5.5	-	48.0
3.2.3	5.5	-	-	-	1.5	-	-	-	-	1.5	8.5
3.2.4	-	-	-	-	11.5	-	11.5	-	-	11.5	34.5
	45.5	20.0	20.0	32.5	18.0	-	16.5	-	5.5	13.0	171.0

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